

GEOLOGIC MAP OF THE MTM 85080 QUADRANGLE, PLANUM BOREUM REGION OF MARS

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Introduction: The polar deposits on Mars probably record martian climate history over the last 10^7 to 10^9 years [1]. The area shown on this 1:500,000-scale map includes polar layered deposits and polar ice, as well as some exposures of older terrain. This quadrangle was mapped in order to study the relations among erosional and depositional processes on the north polar layered deposits and to compare them with the results of previous 1:500,000-scale mapping of the south polar layered deposits [2,3].

The polar ice cap, areas of partial frost cover, the layered deposits, and two nonvolatile surface units—the dust mantle and the dark material—were mapped in the south polar region [4] at 1:2,000,000 scale using a color mosaic of Viking Orbiter images. We constructed Viking Orbiter rev 726, 768, and 771 color mosaics (taken during the northern summer of 1978) and used them to identify similar color/albedo units in the north polar region, including the dark, saltating material that appears to have sources within the layered deposits [5]. However, no dark material has been recognized in this map area. There is no significant difference in color between the layered deposits and the mantle material mapped by Dial and Dohm [6], indicating that they are either composed of the same materials or are both covered by aeolian debris [3,4]. Therefore, in this map area the color mosaics are most useful for identifying areas of partial frost cover. Because the resolution of the color mosaics is not sufficient to map the color/albedo units in detail at 1:500,000 scale, contacts between them were recognized and mapped using higher resolution black-and-white Viking Orbiter images.

No craters have been found in the north polar layered deposits or polar ice cap [7,8]. The observed lack of craters larger than 300 m implies that the surfaces of these units are no more than 100,000 years old or that they have been resurfaced at a rate of at least 2.3 mm/yr [8]. The recent cratering flux on Mars is poorly constrained, so inferred resurfacing rates and ages of surface units are uncertain by at least a factor of 2.

Stratigraphy and structure: The oldest mapped unit, Amazonian mantle material (unit Am), is distinguished by its rough, sometimes knobby surface texture. The knobs and mesas of mantle material that crop out within areas of smooth layered deposits suggest that the mantle material was partly eroded before the layered deposits were laid down over them. The layered deposits appear to cover the mantle material except on steep scarps that expose the mantle material. The layered deposits may be more resistant to erosion than the mantle material, so that the steep scarps formed by more rapid erosion of mantle material beneath layered deposits. Therefore, the mantle material in this area does not appear to have been derived from erosion of the polar layered deposits.

The layered deposits (unit Al) are recognized by their distinct bedded appearance, red color and lower albedo relative to the polar ice cap and frost deposits; they appear to be the youngest bedrock unit in this area. In both polar regions, layers are apparent at least partly because of their terraced topography, especially where accented by differential frost retention [13,14]. Early Mars Orbiter Camera (MOC) images show that layered deposit exposures are rough, with evidence for deformed beds and unconformities [16]. No definite

angular unconformities have been found within the south polar layered deposits [2,3], unlike the north polar layered deposits, where truncated layers have been recognized in higher resolution images [7,13]. Angular unconformities have been found in various locations within this map area, including lat 85.7° N., long 61° W., lat 82.6° N., long 82° W., and lat 83.6° N., long 90° W. The unconformities are mapped using hachures on the side of the contact where layers are truncated. The final line color and symbol to be used to map such unconformities will be decided during the production of this map.

The partial frost cover (unit Af) is interpreted as a mixture of seasonal frost and defrosted ground on the basis of its albedo, color, and temporal variability. Bass and others [17] found that frost albedo reaches a minimum early in the northern summer, then increases during the rest of the summer season. This behavior is not observed in the south polar region [2]. The increase in albedo is interpreted as resulting from condensation of H₂O from the atmosphere onto cold traps in the north polar region [17]. Because the images used for the base and for mapping were taken in mid-summer, the extent of the high-albedo units shown on this map is greater than during early summer.

The albedo of the residual polar ice cap (unit Ac) is higher than all other units on this map. The contact with the partial frost cover (unit Af) is gradational in many areas, most likely because unit Af represents incomplete cover of the same material (H₂O frost) that comprises unit Ac. The summer extent of the north polar cap was the same during the Mariner 9 and Viking Missions [17], which suggests that it is controlled by underlying topography. Albedo patterns in these summertime

images are correlated with topographic features seen in springtime images. Areas of the highest albedos must be covered by nearly pure coarse-grained ice or dusty fine-grained frost [18,19]. The presence of perennial frost is thought to aid in the long-term retention of dust deposits [20], so areas covered by frost all year are the most likely sites of layered-deposit formation.

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